Reference Character 44:

The applicant has amended the text on page 9, lines 6 and 7 so as to delete the reference to "negative lead frame" and "position lead frame". Instead, the lead frames 44 are qualified in terms of their connection to a negative terminal or positive terminal of the LEDs. No change is therefore needed in Figure 4.

Reference Character 41:

The reference numeral 41 has been changed on page 10, line 4, and in Figure 6 so that it is now 41'.

Reference Character 43:

The reference 43 on page 10, line 3, has been changed to 43' and a corresponding change has been made in Figure 6.

Reference Character 46:

The two occurrences of the reference numeral 46 on page 14, line 5 and line 18, have been changed to 54 and a corresponding addition has been made in Figure 5.

Reference Character 55:

The reference to "inner wall 55" on page 15, line 8, has been changed to "the inner tube 55".

The objection in paragraph 3 of the official letter relates to multiple use of the references 41 and 43 in Figures 4 to 6 and 8. The changes noted above in Figure 6 deal partially with this objection. In addition, the text on page 14, line 4, has been amended so as to insert after "incorporates" the words "a light guide 41 and cluster of LEDs 43 as shown in Figure 4, together with". This amendment makes it clear that the component assembly shown in Figure 4 is substantially the same as that shown incorporated in the device of Figure 5. Furthermore, the reference 41 in the penultimate line on page 10 has been changed to 41" and a corresponding amendment has been made in Figure 8.

The objection to the use of the character 61 in Figure 7 is consistent in that it is used in relation to each of a bundle of shaped fibres, which may be different in cross-section, but which are not described in any detail in the text.

The amendments proposed above are incorporated in the amended paragraphs and are shown in red on enclosed proposed corrected drawing sheets.

As regards the claim rejections under 35 USC Section 112, the applicant has amended claim 20 so that it is dependent on claim 19, not claim 20. Also, the applicant has amended claim 21 to be dependent on claim 1.

As regards the claim rejections under 35 USC Section 103, we submit that these are not well founded for the following reasons.

The invention of claim 1 is specifically concerned with an optical irradiation device in which multiple LEDs are clustered together as closely as possible so that they emit radiation into a single beam with the highest possible radiation density. To allow closer clustering of the LEDs, they are formed with faceted side faces that abut, for example, in the manner of a honeycomb, so that compared with a standard LED with a cylindrical cross-section, more LEDs can be packed into a unit cross-sectional area. Hence, the beam of radiation formed by radiation emitted from the tips of the LEDs has a higher intensity per unit area.

Therefore, according to the invention, it is essential:

(i) That LEDs are used,

(ii) That the LEDs are faceted and packed together closely, and

(iii) That the LEDs emit radiation from their tips into a beam of radiation with an increased density of radiation per unit area of cross-section because of the closer packing of the LEDs.

Considering reference US5873645, the Examiner compares the light source or projector 12 with the LED cluster of the invention. However, the light source 12 comprises

"one or more light bulbs" (column 2, line 1) and nothing is said about the manner in which these light bulbs are packed together in the projector 12, nor that they should be packed together closely. Instead, the light bulbs 12 provide light to a plurality of fibre optic strands 14, each of which terminates in a corresponding cell 22 of a honeycomb cell structure 20. Each cell 22 has highly reflective internal surfaces to reflect the light emitted from the end of the fibre optic strand 14 in a forwards direction to form part of a light display, such as a traffic signal light, television screen, VDT display or lighting fixture (column 2, line 56 to 65). Thus, the fibre optic strands 14 serve to disperse the light from light source 20 over a display area formed by the honeycomb cell structure 20. Significantly, the display area occupies a larger area than the bundle of fibre optic strands 14 at the light source 12, as shown in Figure 1, this being consistent with the reference to the light source 12 as a "projector", and the purpose of the cell structure 20 as a display (Figures 5 to 12). The reference is therefore concerned with dispersing light from a projector or source 12 to the wider area of a display, which will involve a reduction in radiation density per unit area. This is quite clearly a different objective to that of the invention and results in a different structure to that of the invention, in which the LEDs are not clustered together and do not emit radiation in a beam of correspondingly increased density per unit area.

The reference US5875645 describes the use of LEDs 32,34,36 instead of the optic fibre strands 14 (column 2, lines 53 to 55 and Figure 4) where one or more LEDs are mounted in each cell 22. However, these LEDs are all spaced apart from one another, both within each cell (Figure 4), and from one cell to another. Thus, there is no clustering of the LEDs that would produce increased density of radiation in the emitted light beam as required by the invention of claim 1. The reference is simply not concerned at all with the density of radiation emitted by the fibre optic strands or LEDs, other than to position the fibre optic strands 14 longitudinally within the cells 22 to vary the pattern of emitted light (column 2, lines 22 to 32 and arrow 38 in Figure 1). In fact, the requirement to locate each group of LEDs 32,34,36 within a separate cell 22 of the honeycomb cell structure 20 ensures that the LEDs within each cell 22 are spaced well apart from those in other cells.

In summary, the reference US5875645 does not disclose nor teach the invention.

The reference US5420768 discloses an optical irradiation device in which multiple LEDs are clustered together in a module 10 so as to emit irradiation from their tips into a light guide 17. However, the individual LEDs, as shown in Figure 3, are spaced apart within the matrix of the module, and there is no reference to any potential problem of low power density in the emitted beam in the light guide, nor any modifications to address such a problem.

If the teaching of US5420768 were combined with the teaching of US5875645, then each of the triple LEDs 32,34,36 might be replaced by an LED module 10. But this would not produce the invention of claim 1, either alone or as further specified in the subsidiary claims, including claims 16 and 28 or claims 21 to 27 and 29 highlighted by the Examiner.

We note that the Examiner is prepared to allow claims 19 and 30, and these claims are retained. The applicants now request that a similar favourable decision be issued in respect of the remaining claims.

I authorize the Assistant Commissioner to charge any deficiencies, or credit any overpayment associated with this communication to Deposit Account No. 50-0852. A duplicate copy of this sheet is enclosed.

Respectfully submitted,

REISING, ETHINGTON, BARNES, KISSELLE,
LEARMAN & McCULLOCH, PLLC

Eric T. Jones
Registration No. 40,037
P.O. Box 4390
Troy, Michigan 48099
(248) 689-3500

Date: October 23, 2001

The reference US5420768 discloses an optical irradiation device in which multiple LEDs are clustered together in a module 10 so as to emit irradiation from their tips into a light guide 17. However, the individual LEDs, as shown in Figure 3, are spaced apart within the matrix of the module, and there is no reference to any potential problem of low power density in the emitted beam in the light guide, nor any modifications to address such a problem.

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We note that the Examiner is prepared to allow claims 19 and 30, and these claims are retained. The applicants now request that a similar favourable decision be issued in respect of the remaining claims.

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LEARMAN & McCULLOCH, PLLC

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Date: October 23, 2001

IN THE UNITED STATES PATENTAND TRADEMARK OFFICE

In re application of:
Robin Walter Mills et al.

Serial No. 09/509,433 Group Art Unit: 2875

Filed: May 30, 2000 Examiner: I. Negron

For: OPTICAL IRRADIATION DEVICE

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**MARKED UP COPY OF SPECIFICATION AND CLAIM 20**

Honorable Commissioner for Patents
Washington, D.C. 20231

Sir:

IN THE SPECIFICATION:

The title is amended as follows:

[OPTICAL IRRADIATION DEVICE] OPTICAL IRRADIATION DEVICE LED AND OPTIC FIBRES.

The paragraph starting at line 20 on page 8, is amended as follows:

The electrical connections of the LEDs, known as lead frames 44, are connected to respective positive and negative power terminals or bus bars 42. Preferably, these terminals are adapted to serve the dual function of heat sinks to help remove heat generated by the LEDs 43. Thus, the terminals are formed of a good thermal conductor such as copper, and are located in the optimum location relative to the LEDs and the external surfaces of the device. In one particular embodiment most suited to the LED

array of Figure 3, the terminals 42 take the form of two concentric rings, each lying adjacent to the bases of one ring of LEDs 31 or 32. Preferably, the negative terminal is the outer one because the [negative] lead frames 44 [of the LEDs generally get hotter than the positive lead frames 44] to the negative terminal of the LEDs generally get hotter than the lead frames 44 to the positive terminal of the LEDs.

The paragraph starting at line 4 on page 10, is amended as follows:

In another embodiment of the invention, illustrated in Figure 6, two or more adiabatic tapered light guides [41] 41' are arranged in series, each with a corresponding cluster of LEDs [43] 43', but with successive clusters forming a ring around the end of one light guide as it connects to the next. Alternatively, each successive ring of LEDs 43 may be replaced by just one or a fewer number of LEDs. This arrangement allows the overall diameter of the device to be kept relatively small as the LED clusters 43 are arranged in groups along the length of the device.

The paragraph starting at line 4 on page 14, is amended as follows:

Figure 5 shows a device according to the invention which incorporates a [heat pipe 45 as a single lumen in the main body 46 of the device] light guide 41 and cluster of LEDs 43 as shown in Figure 4 together with a heat pipe 45 as a single lumen in the main body 54 of the device. The hotter of the LED leads is preferably placed nearer the heat pipe 45 or outer case 47 of the LED cluster so that the heat path of the hotter lead is shorter. A thermal connector 48 may be provided between the LEDs 43 and the end of the heat pipe 45. If required, additional forced cooling means may be used for example, a fan 49 or Peltier device 50 in juxtaposition to the pipe. In addition, a heat sink 51 may be provided.

The paragraph starting at line 20 on page 14, is amended as follows:

For portable use, the LEDs are operated from batteries 52, which are located in a hand grip 53 attached to the body [46] 54, in Figure 5. However, the heat pipe design can be modified as shown in Figure 9 to accommodate batteries. The heat pipe consists of two concentric heat conducting tubes 55,56 with a folded interstitial heat conduction element 57 between these tubes similar in appearance to a length of corrugated sheet rolled into a tube. This lies within the concentric tubes. The wicks 58 of the heat pipe can then be placed in alternative grooves in the corrugated sheet, while the empty grooves 59 allow for the rapid movement of the vapour formed at the warmer end of the heat pipe.

The paragraph starting at line 9 on page 15, is amended as follows:

By designing the heat pipe in this way batteries, capacitors, supercapacitors or other energy source 60 can be located within the inner [wall] tube 55 of the heat pipe.

IN THE CLAIMS:

Claim 20 (amended). A device as claimed in claim [20] 19 in which each successive guide is provided with a ring of LEDs around the output end of the preceding guide.

Respectfully submitted,

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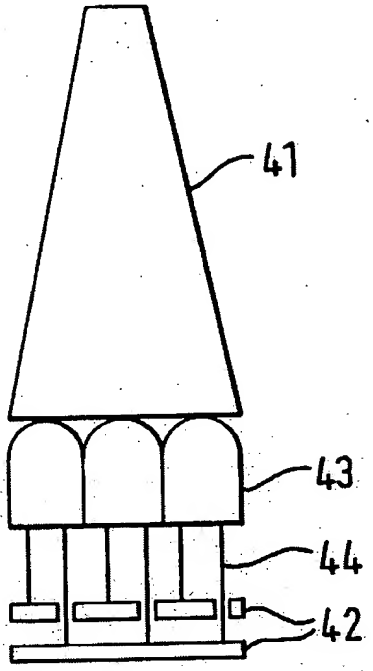
(248) 689-3500

Date: October 23, 2001

PROPOSED CORRECTED DRAWING SHEETS

Mills et al
09/504,433
Sheet 1 of 3
2/4

FIG. 4



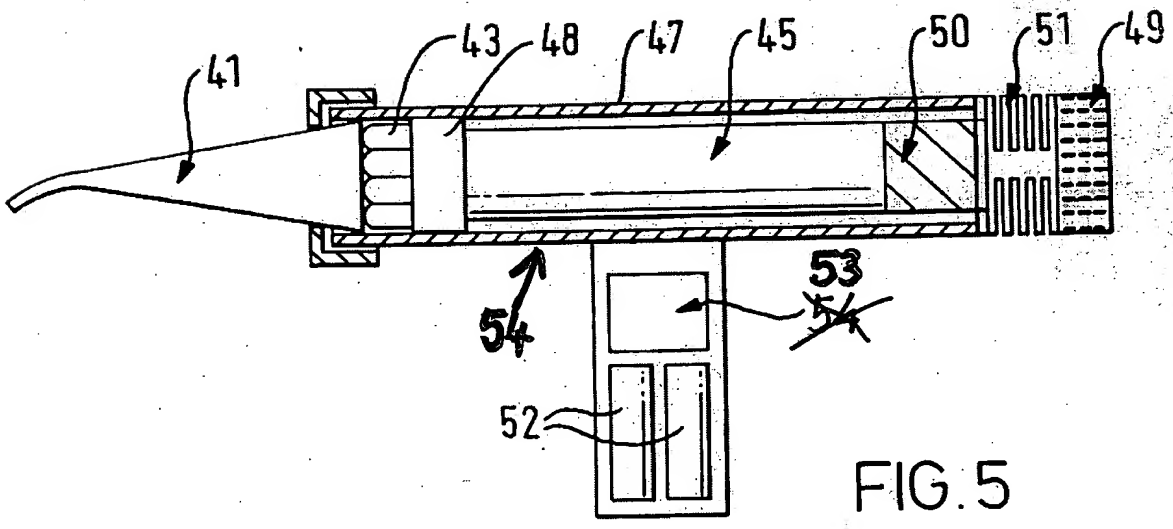




FIG. 5

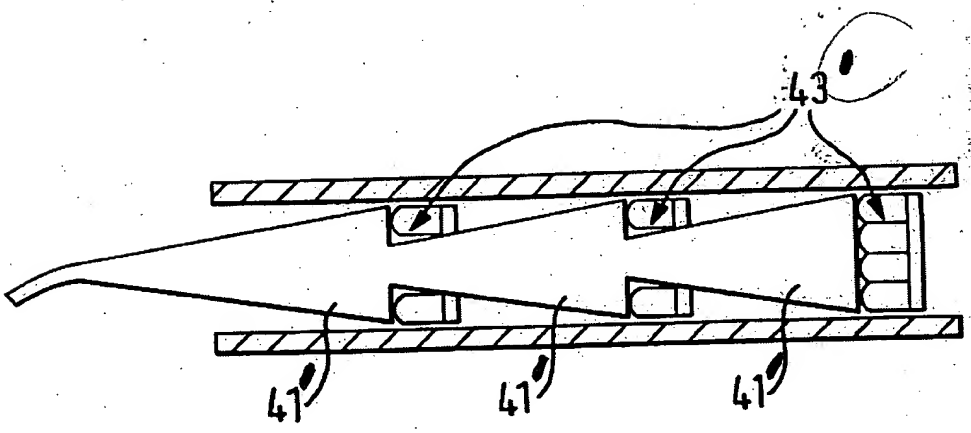



FIG. 6

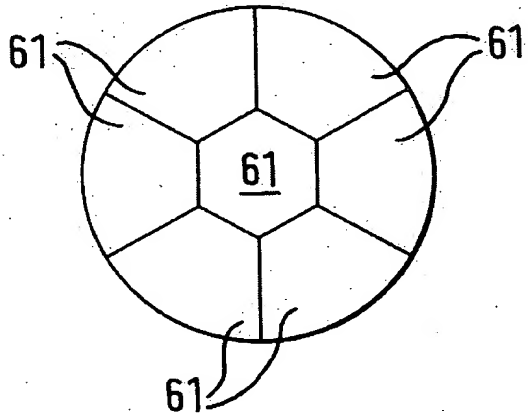



FIG. 7

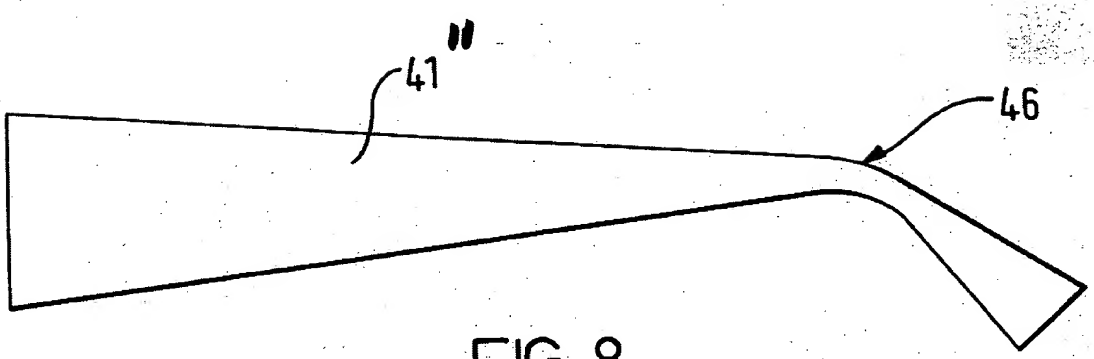



FIG. 8

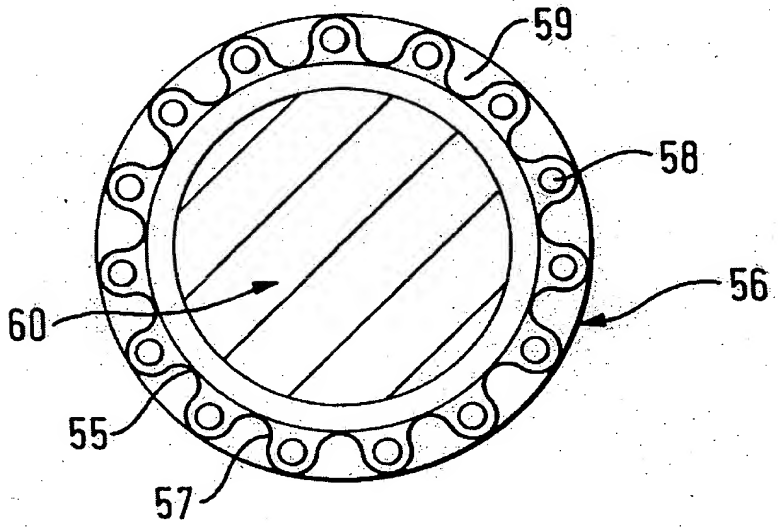



FIG. 9